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NEBC MEETING NEWS

March 1999. Thomas J. Rawinski, Director of Ecological Management at Massachusetts Audubon's Center for Biological Conservation, addressed the Club on the topic "Travels through Virginia: Botanical Wonders and Conservation Victories." It was a partial accounting of his seven years away from New England, or in his words, "a report back to the hive," regarding his employment as an ecologist with the Virginia Division of Natural Heritage, part of the state's Department of Conservation and Recreation. Using slide images and recounting many botanical discoveries and new natural areas protected as a result of the Division's efforts, he gave us an overview of the state's natural areas and botanically diverse ecosystems. He reminded us of how much M. L. Fernald had loved Virginia, noting that Fernald added more new species to his 8th edition of *Gray's Manual of Botany* from Virginia than from Newfoundland, another area he had explored extensively.

Contrasting Virginia with New England, Rawinski said Virginia has only two natural lakes, lacks some northern taxa such as *Chamaedaphne*, and is nearly devoid of paper and gray birch. As evidence of a richer flora than New England, he noted that there were 25 oaks, 8 pines, 6 magnolias, 25 *Rhynchospora* spp., 13 *Vaccinium* spp., and 10 *Trillium* spp., plus representation by families such as the Bromeliaceae and Loganiaceae. Virginia endemics include three species of *Clematis*: *C. addisonii*, which occurs on dolomite; *C. coactilis*, a species found on both dolomite and shale; and *C. viticaulis*, a narrow endemic found only on shale barrens. Other endemics include *Helenium virginicum*, a species of acid ponds in the Shenandoah Valley, and *Iliamna corei*, a species for which they found fire worked well as a management tool.

The clearly defined physiographic provinces of the state helped Rawinski orient us to the state's major geological and climatic regions and to the locations of unique habitats for plants within them. Elevations range from the 5700 ft. high Mt. Rogers in the Blue Ridge Mountains in southwestern Virginia to sea level where one can find extensive tidal marshes. He compared the Piedmont of Virginia to Worcester County, Massachusetts, pointing out that neither is diverse in habitat types, but that each possesses some interesting ones, such as those with diabase bedrock.

Botanical hot spots are clustered in habitats such as shale barrens, sea-level fens, and dolomite outcrops: types found primarily in the eastern or western parts of the state. Using habitat characteristics as primary indicators, he and colleagues located 30 new state records, such as *Carex arctata* and *Sporobolus heterolepis*, between 1990 and 1997. Recent funding of 11.5 million dollars through a bond bill has allowed the Department to add over 20 new natural areas to its preserve system.

Rawinski highlighted certain ecosystems. More than 500 potential shale barrens were identified by the Heritage Division; they typically occur on steep hillsides undercut by streams. An abundance of limestone in the Shenandoah Valley and elsewhere has resulted in some notable dolomitic cliffs and, in the southwestern corner of the state, some calcareous glades with taxa such as the newly described clover species, *Trifolium calcaricum*. Dolomite glades supported the globally rare *Echinacea laevigata*, which can be found growing in loamy, dolomitic soil with prairie taxa such as *Castilleja coccinea* and *Senecio plattensis*. A priority for protection in Rawinski's eyes was an ultramafic barren (i.e., a serpentine-like area with high magnesium levels) in the Piedmont supporting several disjunct and rare species. Buffalo Mountain, a monadnock in the Blue Ridge, supported a diversity of vegetation associations and herbaceous species, including nine rare species for the state. Rawinski postulated that the thin soil mantle and open glade habitat is maintained by a natural deficiency of clay, which facilitates lateral movement of water and washing of any deposited soil. Ultramafic fens are another botanical hot spot in Virginia, providing habitat for 20 state-listed rare species, including a state record discovery: *Tofieldia glutinosa*. A truly significant area in the Piedmont is Fort Pickett Military Reservation, where frequent fires have maintained a population of the very rare sumac, *Rhus michauxii*, it occupies hundreds of acres, making it by far the largest known population.

The Coastal Plain, as in New England, has many ponds, but in Virginia they are sinkhole depressions over 100,000 years old. Here one can find large overcup oaks, *Quercus lyrata*, and rare herbs such as *Carex joorii*, *Hottonia inflata*, *Sabatia campanulata*, and *Chelone cuthbertii*. In an especially dry year, ten new *Fimbristylis perpusilla* records showed up at pond sites. Other coastal plain communities of special interest are sand hills with longleaf pine, pocosins or shrub bogs, sea level fens, and cypresstupelo swamps, where Virginia big-eared bats can be found in cavities of the ancient trees.

For more information on Virginia natural areas and biota, Tom Rawinski advised seeking out the Virginia Department of Conservation and Recreation's web site.

April 1999. Michael Donoghue introduced the "NEBC 1999 Distinguished Speaker," Dr. Peter Raven, Director of the Missouri Botanical Garden. Accomplishments and qualities mentioned included (1) his ability to organize and galvanize people around ideas and visions, (2) his authorship of *The Biology of Plants*, (3) his collaborative research on the Onagraceae as a model for systematic botany, (4) his leadership in coordinating the Flora of China project, and (5) his leadership in conservation of biological diversity, including serving on the President's Commission on Science and Technology and co-authoring a paper entitled "Teaming with Life," a statement on the need and mechanisms for preserving biodiversity.

Dr. Raven addressed the topic, "Plant Conservation Globally and Locally." He explained that his approach would be to paint the broadest picture possible of the current crisis in biological conservation around the world and why the crisis exists. His main objective was to stimulate our thinking about these issues and invite a dialogue about strategies for combating the problem. Raven's broadest picture included a review of 3.8 billion years of biological evolution on the earth and the five major extinction events that have influenced its pathways to the present. The first three extinction events occurred when life was restricted to the marine world. He pointed out that terrestrial life began 430 million YBP, at a time equivalent to 90% of the way through the time-line of earth's existence. He emphasized the importance of cyanobacteria in making colonization of terrestrial habitats possible by changing the earth's atmosphere to an oxidizing one. The resulting increase in oxygen produced by their photosynthetic activities over 3 billion years made possible the production of a stratospheric ozone layer that allowed the ancestors of the four groups dominant on land at the present time (arthropods, fungi, terrestrial vertebrates, and plants) to colonize terrestrial habitats. The fourth great extinction event occurred at the end of the Permian, about 280 YBP, impacting the earth's first forests and early dinosaurs. In the following Mesozoic Era, dinosaurs and cycads flourished and angiosperms evolved, making life much more diverse than previously.

About 65 million YBP, at the end of the Cretaceous Period, the fifth great extinction occurred, presumably as the result of a large meteorite crashing into the earth off what is now the Yucatan Peninsula. The collision created an opaque cloud around the globe that impeded photosynthesis and, according to estimates by David Raup et al., eliminated two-thirds of terrestrial species in a short period of time. At that point, Raven estimated loosely that the number of eucaryotic organisms remaining may have numbered between 500,000–700,000. It took approximately ten million years for life to recover, and the resulting evolutionary pathways led to the evolution of most current groups of organisms. Today, according to a 1997 paper by Sir Robert May presented at the National Forum on Biodiversity at the National Academy of Sciences, the number of eucaryotic species can be estimated conservatively at about seven million. Of these, only about one in four has a valid name. In the tropics, the ratio is much less, around one in twenty. Even for the described species of organisms our knowledge is extremely limited; many are known only from a single specimen at the bottom of a museum vial. No one can give a plausible estimate of the number of procaryotic organisms. One gram of soil in a Norwegian beech forest is estimated to have 5,500 species of bacteria, more than the total number of species recognized formally from the entire world, and how these figures relate to other ecosystems around the world, or to the total number of bacterial species, is unknown. Even more poorly known, Raven says, is the multitude of relationships that mediate the flow of energy through the globe's ecosystems and other aspects of their functioning.

Bringing humans into the picture, Raven drew attention to our *Homo erectus* ancestors who migrated out of Africa and discovered fire-making, causing some low-scale disturbances approximately 1.5–2 million YBP. *Homo sapiens* appeared on earth about 200,000 YBP and arrived in the New World 14,000–16,000 YBP. The cultivation of crops began at about 10,000 YBP at a number of widely-scattered centers, when there may have been only several million people globally, a population equivalent to that of the Greater Boston area today. Agriculture allowed for a reliable food source, and by the time of Christ the earth's population had grown to around 120–150 million. By the Renaissance, it had grown to 0.5 billion, and by the time of Thomas Malthus, who speculated at the start of the Industrial Revolution that human populations would outstrip agriculture's ability to produce food, about 1 billion people were walking the earth. By 1950, our numbers had increased to 2.5 billion, and now 50 years later, the earth's population has reached nearly 6 billion, bringing even greater importance to questions of sustainability.

"Sustainability and biodiversity are two sides of a coin," Raven said. Can the human world sustain itself while maintaining global biological diversity? The results of the last 50 years are not encouraging. One-fourth of the world's topsoil has been lost and one-third of the world's forests have been destroyed since World War II. There has been a drastic increase in extinction rates. It is estimated that extinction rates have increased 100 × since the Renaissance and are 1000 × background rates, based on fossil records. The rates are accelerating, according to extinction models developed by Stuart Pimm et al. using island biogeography theory, and may reach 10,000 × in the next century. Over the next 25 years, they estimate that one-third of tropical organisms will become extinct or be on the way to extinction, and that by the end of the next century, three-fourths of all tropical organisms and two-thirds of the worldwide total will be gone or on the way to extinction. *Homo sapiens*, Raven says, is driving an extinction event comparable to the scope of the fifth major extinction event 65 million years ago. Nothing could be as damaging to the future of our species, primarily because of our direct dependency on other living organisms. The 350,000 species of photosynthetic organisms—plants, algae, and a few bacteria—are responsible for all productivity on earth, and human beings obtain all their food from plants directly and indirectly. Another anthropocentric reason for preserving biodiversity is that three-fourths of humanity depends directly on biodiversity, mostly plants, for its pharmacopoeia while the remaining quarter go to drug stores and derive such benefits indirectly. Why say the 21st century will be the "Age of Biology," Raven asks, if all of the organisms are going down the drain? Where will we get all of the organisms to create new products or to use in new sustainable systems, or for that matter to use in bio-engineering new biological products or life forms? He cautions us to heed Aldo Leopold's advice and follow the "first rule of intelligent tinkering" by "saving all of the cogs and wheels."

Raven asks, "What things are in the way of fixing the problem?" One is the sovereignty and pride of nations that inhibit our ability to pay attention to one another internationally and establish global solutions. He cites the United States' failure to sign the "International Convention on Biological Diversity" as a prime example. A second appears to be greed and waste by the developed world, because Raven described the industrialized nations as possessing 20% of the world's population and 85% of the world's wealth, while creating 80–90% of its pollution. In the world today, 360 billionaires have wealth equal to what two billion of the poorest people earn in a year. The people at the low end of the economic spectrum are totally disenfranchised, which denies the rest of the world the potential benefit of their wisdom and creativity. We simplify when we say "over-population" is the problem globally. For instance, Brazil and Mexico have had population control policies for 20 years and have slowed population growth and improved education for women, whereas the U.S. has no population policy, despite a doubling of its population in the past 50 years and a standard of living 30–40 times that of Brazil or Indonesia. Because of our consumptive standard of living, the impact on the environment of doubling the U.S. population (adding 135 million people in 50 years) is equivalent to adding 4 billion people to populations in Brazil or Indonesia.

We do not need to waste at the levels we do. The United States wastes twice as much per capita as in Europe. We are living as if there is no tomorrow and in denial that our economy is related to the rest of the world. What can we do to help create a more sustainable world and slow the loss of biological diversity? Raven's answers include: (1) be leaders in showing the way rather than demanding that the third world lead the way, (2) pay attention to internationalism by convincing others that the 80% of the world's people living in non-industrialized countries are of deep and profound importance to us, (3) vote and encourage others to do so, (4) support conservation groups you are congenial with philosophically and then support sustainability, and (5) think about what you are doing personally and make wise choices. Raven says, "Think about what is just, what is stable, what is sustainable. Think about a world within which biological diversity, cultural diversity, beauty, music, poetry, philosophy, literature, and all the things we value and cherish can coexist. What do we do to create a world that will maintain these things?" We can be optimistic or pessimistic amidst the "gloom and doom" that we face. "Yes, the world will become more homogeneous and less diverse," Raven acknowledges. But the future depends on how we live now, he says. "If you want to be optimistic, do so because of your own determination to do something about it," says our 1999 Distinguished Speaker, as he leads the Club forward into its second century.

—PAUL SOMERS, Recording Secretary